

A Contribution on the Life History of the male *Filaria medinensis* founded on the Examination of specimens removed from the abdominal cavity of man.

BY

SURGEON R. HAVELOCK CHARLES, M.D., M.C.H., F.R.C.S.I., F.Z.S.,

BENGAL MEDICAL SERVICE, PROFESSOR OF ANATOMY AND COMPARATIVE ANATOMY, MEDICAL COLLEGE, LAHORE ;
SURGEON, MAYO HOSPITAL, LAHORE ; FELLOW OF THE PUNJAB UNIVERSITY.

THE specimens of which the accompanying sketches are fairly faithful representations were removed from the sub-peritoneal tissue of "subjects" undergoing dissection in the Anatomical Department of this College. Figures 1, 2 and 3 represent the calcified remains of specimens of *Filaria medinensis* in various stages of development. These came from one "Subject," and were found in the neighbourhood of the R. Ext. Iliac Vein. The largest was lowest down, the smaller ones being near the R. Sacro Iliac Art. The length of Figure 1 I compute to be about 266 mm. and its diameter 1.8 mm. The smallest specimen, Fig. 3, did not measure, previous to undergoing calcification, more than 30 mm., and its diameter is 0.5 mm. It may have been on its migration from the alimentary canal some time, so that its size on escaping from the intestine was probably very much less than the foregoing measurement. The cellular tissue around was thickened as if it had been the seat of old inflammation. The calcified remains are each surrounded by a sort of boundary membrane, which evidently, on the subsidence of the inflammation, closed them severally off from the general economy. Why the worms died it is impossible to say. It is probable that, if the host suffered from continued fever of a high temperature, their vitality may have been interfered with and their destruction ensured. Enlarged spleen was present, thus showing that the host had in his time been a malarial subject. The worms having died, the deposition of lime salts in their tissues is easily understood. This calcification has left beautiful casts of the worms, demonstrating well the rounded shape and the calibre of the body. Neither head nor tail can be made out. I consider there is no doubt that the specimens represent immature guinea-worms. My reasons for considering them so are—

- (1) Shape of body proves them round worms, Nematoda ;
- (2) The calibre, 1.8 mm., and length, 266 mm. (about), agrees with that of *Filaria m.* ;

-
- (3) The *Eustrongylus* *Gigas* has a similar length, but its calibre is much greater, and, moreover, it is very rare in man : the kidneys also of the "host" were not diseased;
 - (4) The finding of uncalcified specimens (Figures 4 and 5) of guinea-worms in another "subject" a few weeks later confirmed the suspicions I already had of the affinity of the calcified parasites.

Figures 4 and 5 are drawings of Nematoda taken from near the attached portion of the mesentery from out of the sub-peritoneal tissue—in the vicinity of the Ileo-cecal valve. I regret the specimens were injured on removal. The remains of the largest—Figure 4—I have joined together, and so obtained a sketch of a worm presenting all the characteristics of *Filaria medinensis*. On examining two (there is only a drawing of one of these—the second unfortunately was placed in spirit and hence spoilt—that of which the drawing is made was preserved in glycerine) I was struck by seeing something growing from the side of each of them. This "something" I found to be a round worm with the characters of that to which it was attached. On drawing upon it with a forceps I found, to my astonishment, that it was possible to pull it out of the body of the larger worm from a small opening near its middle (thus showing that it was not a case of a worm with a bifid body). I did not completely pull it out, and only withdrew it about 1 cm. I was then of the opinion that I had found a male and female round worm in the process of copulation and at the same time that I had discovered the long sought for male *Dracunculus*! The female (Figure 5b) was 148 mm. long and 1·2 mm. in diameter: the posterior extremity of the body, however, was broken off. The male (Figure 5a) was much smaller and somewhat shrivelled, though showing in every way the peculiarities of a separate individual Nematode. Want of leisure compelled me to place my specimens aside. This I did, preserving the fragments of one male and female (Fig. 5) in glycerine and of another male and female in spirit. A single large female (Figure 4) I placed in glycerine. This was in March last. Furlough to Europe has prevented me prosecuting the subject further at an earlier date. The specimens have suffered somewhat, but even now the male and female in copulation (Fig. 5) can be well seen, though the male has been considerably injured. No embryos or ova can be made out. It cannot be expected, however, that embryos should be found, as the ova would not be fertilised, or rather the embryos would not be freed from the ova till some time after fertilization, which was just in progress. The head with the mouth can be seen. There seems to be a dilatation behind the mouth (- pharynx). The tubercles on the head are shown in Fig. 6, which figure also illustrates the character of the muscular pharynx. The mucronate tail is well marked in Fig. 5. Under a low power the transversely striated cuticle covering a muscular body is apparent. The tail of the male is in the body of the

female, and hence cannot be seen ; otherwise, the characters of his body are similar to those of hers.

I shall now briefly trace the life history of the guinea-worm. Beginning with the female, heavy with young, drawn from the body of the human host by the itinerant barber, who ignorantly casts the extracted worm on the ground, where the decomposing body gives issue to thousands of living embryos. These, gaining water by means of the wind or rain, migrate (according to Fedchenko) into the body of a cyclops, upon which they become parasitic, becoming coiled up within its limbs ("as many as 6 or even 12 of the parasites being occasionally found within the body of a single crustacean host"), and reaching there full larval growth. A human being drinks the water containing the infected cyclops. The juices of his intestine, digesting the Entomostracan, liberate the matured larvæ—*male and female*. Rapid growth takes place in these. The males attach themselves to the females, both leaving the intestine together for the safer retreats of the retro-peritoneal tissues. The exodus probably occurs where the mesentery is attached to the bowel—the planes of peritoneum forming the mesentery directing their course in the sub-peritoneal connective tissue to the back of the abdomen in the neighbourhood of the lumbo-sacral articulation, where, in a nidus, well-nourished by the abundant blood supply, the female parasite can remain at ease and grow at leisure, unaffected by the contractions of muscles, and undisturbed by surface chills. She increases in size from the growth of her uterine organs. The poor male, gradually diminishing, comes to appear only as an appendage to his mate—having completed the task allotted to him—that of fertilising her.

The time the female remains in these internal regions will vary according to the state of development of her contained embryos. On maturation the wandering again takes place—may be down on the Psoas under Poupart's Ligament, being guided by the muscular planes to "point" on under surface of the deep fascia in some region of the thigh or leg, just as a Psoas abscess may "point" either in the inside of thigh or as low as side of ankle! A more posterior exit from the abdominal cavity—that by the Gt. Sciatic Notch in company with the Sciatic Ns. and Vs. to the buttock—would lead the wanderer down the back of thigh to calf by way of the Popliteal space. Having arrived under the deep fascia, it would act as a foreign body. Interfering with the proper contraction of the muscles, the irritation of its presence would cause an abscess by which the imprisoned worm would be liberated. The male dies in the sub-peritoneal tissues, the female finishes her course on the surface of the body!

In the life history and morphology of the *Filaria medinensis* certain points are up to this doubtful or unknown. As (1) Where does the impregnation of the female occur? (2.) What becomes of the male? (3) How is it that no sexual orifice has been discovered on the body of the female?

Claus (Sedgwick's Translation, 1889) says, "Whether they first escape" (*i.e.*, from the body of the cyclops) "and copulate in a free state is not known." Cobbold (1879) says, "It is probable that sexual maturity is next acquired within the human stomach, copulation following." Granting that the specimens found by me are male and female guinea-worms, Cobbold's view would be correct. This learned Helminthologist a little further on says, "The females migrate to the situations in which they are found beneath the skin of the human bearer, *whilst the male perishes and passes out with the faeces.*" The italics are mine. This, however, is not so. The female pierces the wall of the intestine *accompanied by the male*, which remains attached to her body till impregnation be fully accomplished. Then dying, his body, gradually shrivelling up, would not be discovered when the female had reached her host's skin. Copulation in this instance is a slow process. The male is, as it were, a parasite on his paramour, and being attached to her genital aperture (as in parallel cases amongst the lower Crustacea) gradually wastes away in the delights of love! This explains why the male has not been discovered with the adult female on her arrival at the body surface. Although no sexual orifice has been found on the adult, yet such an opening may be seen on the young form after it leaves the intestine, as, at that time, its uterine organs are not distended with crowds of microscopic embryos, causing almost an obliteration of the perivisceral cavity. The Vulva is small in comparison to the size of the worm, and is only used for impregnation, *not* parturition: therefore, as development proceeds—there being no necessity for its presence—it would degenerate and diminish as the body swelled from the contained embryos. But if the parasite be discovered in the neighbourhood of the mesentery—that is, soon after its start on its journey—and a second parasite be found attached to the side of the larger, out of an opening on which it can be withdrawn, are we not justified in saying that the orifice in the larger worm is a genital aperture, and that the attached worm, which was withdrawn out of this aperture, is the male parasite?

The reason why the male form has not before been met with, I think, is probably due to the fact that it is only likely to be found on a *dissection* of an *infected* subject, and not merely on the *post-mortem* examination of a body containing the parasites in the regions in which I discovered them. The male wastes and becomes small, having impregnated the female. He dies in the abdomen, and his attached remains in all likelihood would be lost owing to the friction of the tissues on the body of the female during her progress down the extremity.

The discovery of comparatively large females, and of males and females together, in the abdomen practically proves that infection with this parasite takes place by the alimentary canal, and finally disposes of the old idea that the parasite could gain entrance by the skin of the extremities or back. It passes *from within out*, NOT from without in.

In conclusion, I may suggest the possibility and probability of cases of Psoas and Iliac abscess and obscure pains in the post-abdominal and pelvic regions being at times due to the irritation of this parasite. The neighbourhood of the Pelvis where the calcified specimens were found showed, as I have previously stated, signs of old inflammation, and the 'remains' were walled off from the system by the usual protective membrane.

Explanation of Plates.

Figures 1, 2, 3. Calcified remains of *Filaria medinensis*, corresponding to three separate worms, ♀ probably.

The "cast" in figure 1 is an excellent one: the round body is well shown; neither head nor tail can be made out. This is the most mature of the specimens, and was found nearest of the three to Poupart's Ligament in the neighbourhood of the External Iliac vein of right side. It is encapsulated by a thin membrane evidently derived from the surrounding tissues and inflammatory in nature.

Figures 2 and 3 are smaller, and represent specimens of a very much less mature age. The diameter of the body of figure 3 is not one-fourth that of the body of figure 1. These calcifications remind one of the convoluted abodes of some of the Tubiculae seen on the outside of shells on the sea-shore.

Figure 4.—Filaria medinensis ♀. Life-size drawing of worm. The three pieces of which it consisted have been placed in position and the sketch made from them. Length about 284 mm. Diameter 1 mm. Papillæ on head not seen. Mucronate tail well shown.

Figure 5.—Filaria medinensis—male and female in copulation. Represented twice the actual size.

The male (*a*) has been somewhat injured about the free end, which is the head; the brownish striæ down from head correspond to the injured "pharynx." This is better shown in the case of the female (*b*), on the head (*d*) of which the brownish marking with a dilatation is seen. The other extremity (*c*) of the female is broken off. The genital opening (*e*) of the female is shown, though it is perhaps represented too definitely. It is the tail end of the male which is within the body of the female. This specimen when found in March last was in excellent preservation. At that time I partially withdrew the male, but did not completely do so, not wishing to spoil the position of the worms. Now, although everything is quite plain, the male is somewhat dilapidated.

Figures 4 and 5—Were removed from near the sacral promontory. It will be noted that in the two "subjects" from which all the specimens—calcified and uncalcified—were removed the seat of the parasites was either in the sub-

peritoneal tissue of the attachment of the mesentery to the post-abdominal wall, or in the same tissue a little further down—the smallest specimen being highest up and nearest to the intestine.

Figure 6.—Drawing of head of female (shown in Figure 5) by means of the Camera Lucida $\times 25$. The tubercles on head are well shown (*a*). The mouth and dilatation behind it (pharynx) will be observed—

- a*= tubercles,
- b*= cuticle,
- c*= muscle fibre,
- d*= internal cylinder extending from mouth,

It will be observed that the alimentary canal is easily seen in the less mature specimens (Figures 5 and 6), whilst in the older and more developed worm the alimentary canal is not apparent (Figure 4).

Figure 7.—Drawing of mucronate tail of worm, shown in Figure 4, by means of Camera Lucida $\times 25$ —

- a*= transversely striated cuticle,
- b*= muscular fibres.

For the sketches of Figures 6 and 7 I am indebted to the kindness of Dr. Murray, Professor of Pathology in this College.

R. HAVELOCK CHARLES, M.D., M.C.H., F.R.C.S.I., F.Z.S.,
Surgeon, Bengal Medical Service.

The 15th December 1891.

Fig. 1



Fig. 2



Fig. 3



Fig. 5

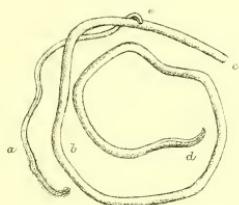


Fig. 4

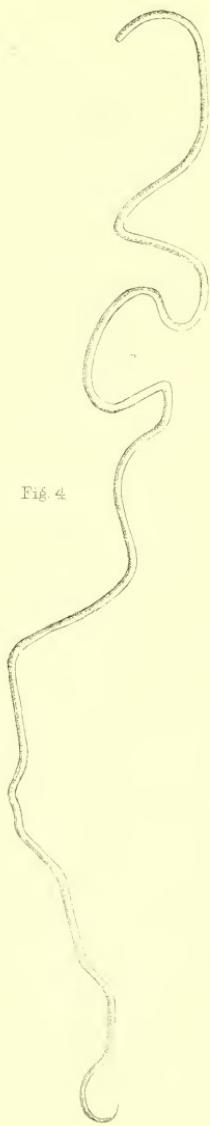
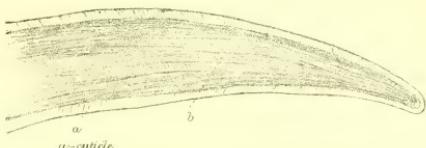


Fig. 6



a-clear tube
b-cuticle clear
c-muscle fibre
d-dark internal cylinder

Fig. 7



a-cuticle
b-muscle fibre

